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Survey of intelligent transportation applications based on cloud computing technology

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ABSTRACT

China is a large transportation country, and in addition to the huge demand for public transportation such as rail transit, private cars on city streets and highways are also a major force, followed by safety issues, and cloud computing plays an important role in today's society, and in some areas where transportation wisdom has been applied, transportation wisdom has become the general trend. As a result, this article will examine and describe the use of cloud computing in urban rail transit information security issues as well as urban and highway traffic safety early warning.

KEYWORDS

Cloud computing; Transportation; Urban rail transit; Highway traffic; Safety early warning.

1. INTRODUCTION

As the scale of urban rail transportation grows, the traditional single monitoring and early warning system architecture has proven unable to satisfy the needs of security early warning and defense application to deep expansion. The traditional early warning system has created an information island, and data from other departments cannot be shared, resulting in disconnection, which delivers a lot of information redundancy and junk information to the operator. There are numerous high-risk security flaws in industrial control devices. The standard vulnerability library has been unable to fight against the most recent attack risks due to its particular stability and security considerations [1]. Once the information system is damaged, vehicle scheduling, fault alarm, security operation and maintenance, communication, and other links will not function normally, putting passengers' safety at risk. Because modern public transportation relies on the traffic network to operate, if the information security of a station is jeopardized and the system is breached, the entire city's public transportation system would be jeopardized and damaged.

The characteristics of urban traffic accidents are high incidence, unpredictability, and complexity, which make the study task of urban traffic safety early warning system difficult. The safety situation on highways is growing increasingly problematic as mileage, traffic volume, and logistics increase. Many transportation difficulties, such as emergency and traffic congestion, are becoming more common. As a result, it is critical to gather reliable, accurate, and timely information for early warning and the elimination of dangers in order to increase traffic efficiency. Although some theoretical findings in these two areas have been obtained both at home and abroad, actual implementation of traffic safety early warning is still absent.

2. RESEARCH SIGNIFICANCE

Because of our country's large population base, the demand for public transportation is high, including rail transit in our country, so the safety of rail transit needs to be paid more attention to. At the same time, our country's level of economic development has improved, the people's requirements for material improvements, the popularity of vehicles is increasing, leading to more and more serious road traffic safety problems. As a result, traditional traffic management systems and technologies are no longer capable of meeting today's demands; and the society urgently wants innovative approaches to improve the efficiency of traffic safety early warning. Nowadays, smart cities based on cloud computing technology have changed the government's methods of managing urban problems and citizens' needs, bringing the government a friendlier, more efficient, and lower-cost method of traffic management and improvement. As a result, this paper will summarize and analyze the application of cloud computing in two scenarios of smart city traffic, as well as provide good development countermeasures for urban traffic development. And can continue to improve application in related fields, as well as improve existing rail transit information security and traffic safety problems.

3. INFORMATION SECURITY OF URBAN RAIL TRANSIT

Rail transit information security is a complex problem involving network, data, communication and other aspects.

Many industrial control devices have high-level security vulnerabilities due to the early construction time and backward equipment of some rail transit systems, and for the safety and stability of the system, the patches corresponding to the vulnerabilities are difficult to update in time, and the current patches have been unable to resist the latest threat attacks and attacks by evolving and evolving viruses. Hackers may attempt to break into, damage, or tamper with crucial systems in the rail transit system's network structure. Malware can infiltrate the system and disrupt train control, communication, and monitoring systems. Rail transit systems typically incorporate user information, which can cause privacy issues if it is leaked. To be able to defend effectively, early warning of these safety problems is especially important, hence the requirement for an urban rail transit information safety warning system, before the occurrence of an emergency, to assist the rail transit system rapid emergency reaction to decrease losses.

3.1. Urban rail Transit Information security Early warning and Defense System Based on Cloud computing [1]

3.1.1. Industrial Control Safety Warning

Gao Chengchao and Xiao Yan proposed building an urban rail information security early warning and defense system based on cloud computing, consisting of a security cloud center deployed in the automation system's monitoring center and a security cloud controller deployed in the station, to carry out early warning and defense of information security. The system was monitored, audited, protected, visualized, and alarmed by placing probes on the cloud computing all-in-one machine and the local cloud computing controller at the station level. [1]

Cloud security monitoring, cloud security audit, cloud security protection, cloud security operation and maintenance are all possible with the technology and design described above.

Although the system may improve the defense and early warning of urban rail transit information security, the delay in information transmission will grow due to data complexity, so the system has limits for some signal systems with high time requirements. Wei Jianhong of East China Jiaotong University proposed in 2018 that system throughput can be improved by adjusting the congestion window of RTT subflows in different situations, and network information transmission delay can be solved by selecting several paths with low delay and energy consumption for transmission [2]. If the

scheme proposed by Wei Jianhong is combined with the cloud-based urban rail transit information security early warning and defense system, the system's processing and application scope for different types of data can be expanded, and application limitations can be reduced.

4. URBAN AND HIGHWAY TRAFFIC SAFETY WARNING

4.1. Cloud architecture and congestion prediction in urban traffic safety early warning system based on mobile cloud computing

At the moment, safety features such as seat belts and airbags provide excellent security to drivers and passengers. More high-tech applications, such as sensors and infrared rays, have been added to the automobile's safety protection system in recent years, however these are just internal measures of the car. In a simple context, it can just notify of a car's safety problem or activate the emergency warning and protection system. The accuracy of sensors and other equipment may be influenced by complicated environmental conditions, resulting in a delay in the warning and protection system triggering, resulting in traffic safety mishaps. As a result, Wang Yongan recommended that a cooperative active security defense system be realized by using wireless communication technology and mobile cloud computing technology to regularly relay the information collected by the surrounding cars through their sensors. [3]

4.1.1. Cloud Architecture

Wang Yongan proposed architecture based on mobile cloud computing, which abandons the limitations of obtaining information and realizing functions only from the PC previously and realizes information and function realization on mobile devices. At the moment, the processing power of mobile devices based on mobile phones is insufficient, and storage capacity is significantly smaller than that of PCS, thus cloud computing just addresses these issues. Server-side cloud computing has a vast amount of data storage and processing power.

GPS positioning is used to retrieve the vehicle's location information in the Android mobile client. Given the disparity between the literature and the writing time of this essay, as well as technological progress, I believe it would be preferable to switch from GPS to Beidou Satellite Navigation System (BDS), particularly in terms of traffic safety. The traditional way of acquiring vehicle speed using GPS and acceleration sensors is abandoned in the acquisition of vehicle speed, but the vehicle self-diagnosis system (OBD) is utilized to obtain real-time speed data, which is more accurate than the traditional speed measurement method. On the server side, it primarily provides storage capacity for huge data flow and performs processing. On the Android mobile client side, I proposed switching from GPS to BDS to acquire location information because the latter's positioning is more exact, which can help the server with data filtering. The PC client is primarily based on a graphical interface, which allows traffic managers to conduct traffic orders and accident handling more quickly based on data from the server. [3]

4.1.2. Congestion prediction

In terms of traffic congestion, the system merely established a congestion time model. Li Shuai, Yang Liu, et al.'s deep learning-based congestion prediction method made contributions to the prediction of congestion situation. [4] The traffic congestion situation can be anticipated by collecting taxi GPS data and comparing it with the road network, then integrating the CNN-Transformer model consisted of CNN spatial component and Transformer temporal component for calculation.

4.2. Data processing and traffic flow prediction in highway traffic safety early warning system based on cloud architecture

In recent years, the highway has attracted the attention of the transportation industry due to its characteristics of high traffic volume, low cost, and ability to strengthen inter-regional exchanges and promote regional economic development, and the importance of the highway has been recognized.[5] However, highway traffic accidents and congestion have become more common in recent years. As a result, improving the ability of highway safety early warning has become an urgent challenge in the current development context.

4.2.1. Traffic flow data processing

Data preparation is required after obtaining traffic data. In general, there are three dominant approaches for repairing data: using current short-term data, historical data from recent days, and real-time data from neighboring lane monitoring. Cheng Cui, on the other hand, used a comprehensive repair strategy in this system, utilizing historical trend data as well as real-time data from adjacent lanes .[6] If there are deleted or missing data, the traffic flow data will also have a high error, so Liu Sheng devised a set of traffic information data compensation algorithms, as shown in formula (1). [7]

$$y(k) = \frac{1}{n}[y(k-n) + y(k-n+1) + \cdots y(k-1)] \quad (1)$$

Where: n is the number taken to calculate the average value. In general, n is equal to 3.

Given the precision of the data required by the system in this research, I believe that combining this algorithm with the authors' data restoration method will improve the system's accuracy.

4.2.2. Traffic Flow Data Prediction

The author predicts traffic flow by using a MapReduce-based neural network technique after gathering accurate and relevant traffic flow data. [6] To begin, the BP neural network method was used to improve learning, slow convergence time, and other deficiencies, and it was then put into the GA-BP algorithm in Figure 1, and the GA-BP algorithm was processed using MapReduce. When the accuracy is met, the map function trains a neural network on the local data and outputs it. The Reduce function extracts the global neural network weights from the map function output.

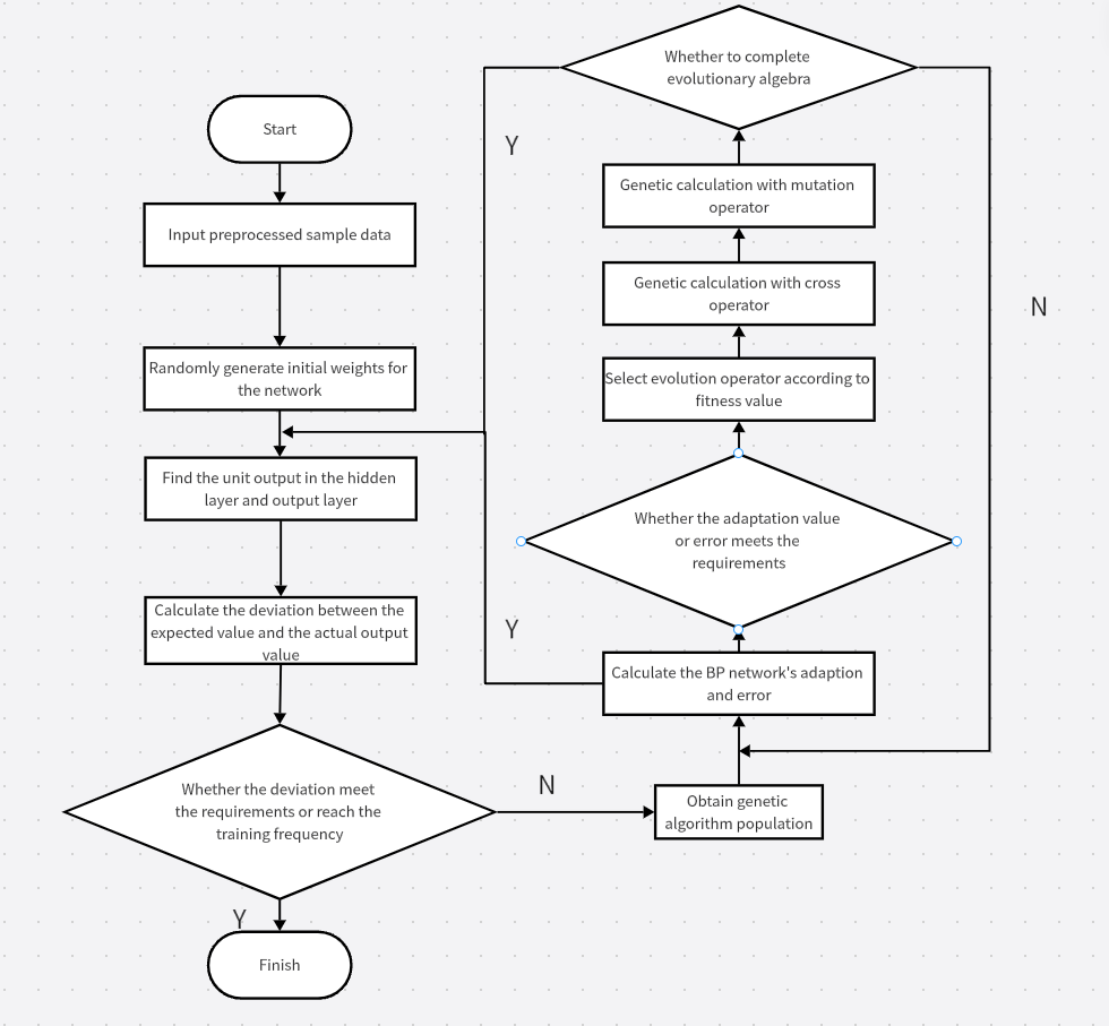

Figure 1. Flowchart of GA-BP algorithm

5. SUMMARIZE THE OUTLOOK

This study focuses on the use of intelligent transportation in the context of cloud computing technology, which is divided into two application scenarios: urban rail transit information security and urban and highway traffic safety early warning. The information security concerns of cloud data centers were highlighted in the context of urban rail transit information security, and the defense and early warning of information security were further presented. A safety early warning system and management platform based on cloud computing technology are presented for urban and highway traffic safety early warning. However, even after analysis and summarization, several issues remain in these specific applications in the two application scenarios. For example, due to the delay in information transmission caused by data complexity, the RTT subflow congestion window developed by Wei Jianhong can be changed to improve system throughput. The design of selecting a number of low-latency, low-energy-consumption transmission channels can solve the problem of network information transmission delay and is brought into the system to help reduce the impact of transmission delay. [2] In addition to the challenges discussed in this research, some application scenarios require the use of cloud computing technologies to optimize and improve. As a result, in the future, we must not only fix the current application's challenges, but also research alternative possibilities.

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